Use of Satellite Data within Weather Decision Support Systems

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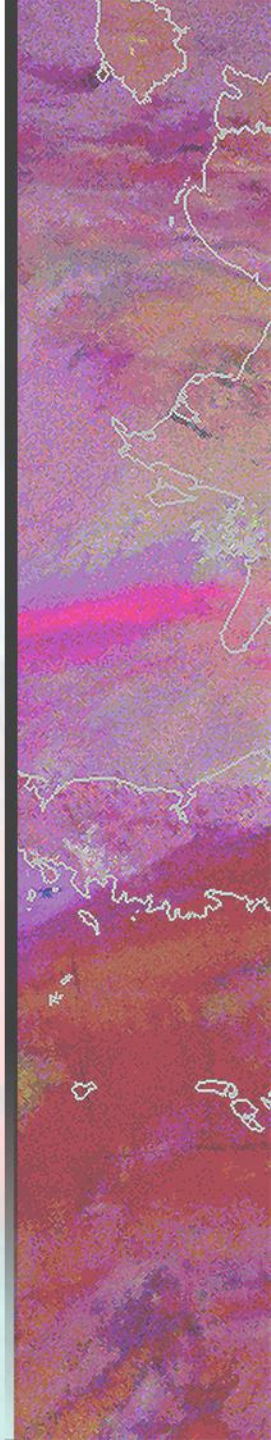
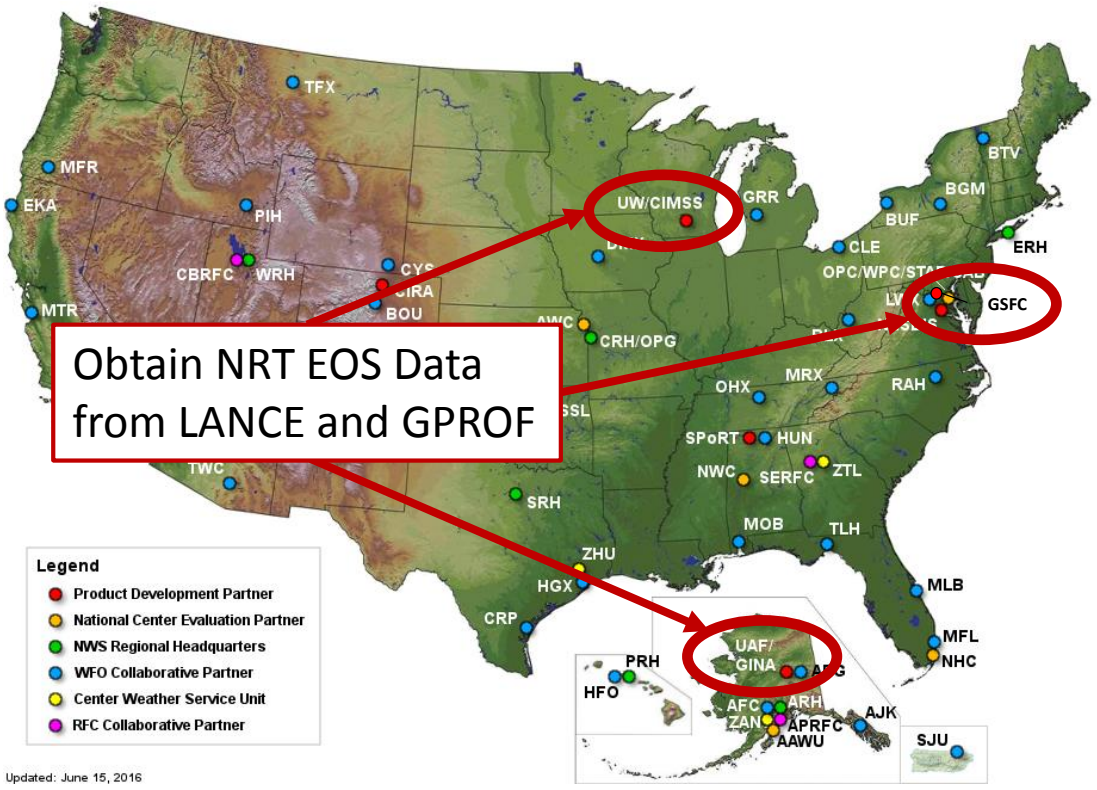


Short-term Prediction Research and Transition (SPoRT) Center Overview

- Transition NASA Earth Science data and research results to the operational weather community for short-term, regional forecasting
- Use NASA research sensors to prepare forecasters for next generation operational weather satellites (GOES-R, Joint Polar Satellite System [JPSS])
- Capabilities and successes are based upon close collaborative partnerships with numerous NOAA/NWS Forecast Offices, National Centers, algorithm developers, and data dissemination teams, including direct broadcast (DB) and LANCE
- "Data Velocity" is a real challenge



SPoRT works closely with end users from 30+ NWS forecast offices and 5 National Centers (e.g., Weather Prediction Center [WPC], Ocean Prediction Center [OPC]). New partnerships include extension to water (e.g., National Water Center [NWC], River Forecast Centers [RFC]) and aviation forecasters.

Use of NASA NRT Data Services

- The SPoRT team uses LANCE data to provide NRT information for weather and disaster applications where DB data are unavailable (e.g., over ocean)
- Obtain data from LANCE through:
  - LANCE API makes it easy to acquire data for specific domains, date/time, etc. to support specific partner needs
  - LANCE FTP subscriptions to fill in data gaps for partners with responsibilities outside CONUS
- NRT MODIS L1 and L2 products from DB and LANCE to support land cover change and atmosphere/cloud weather applications, including low cloud and fog, cyclogenesis, and aerosols
- NRT AIRS L2 temperature, moisture, and ozone from LANCE to support cyclogenesis, severe storms, and NWP
- NRT GPM Constellation L1, L2, and L3 data from GSFC to transition to the National Hurricane Center and select WFO partners

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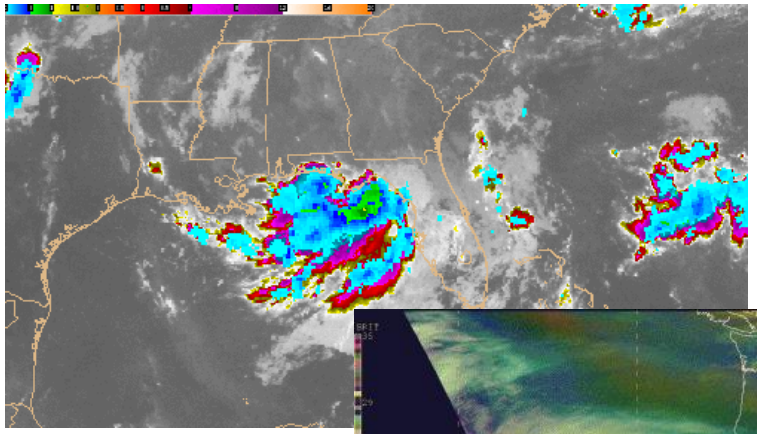
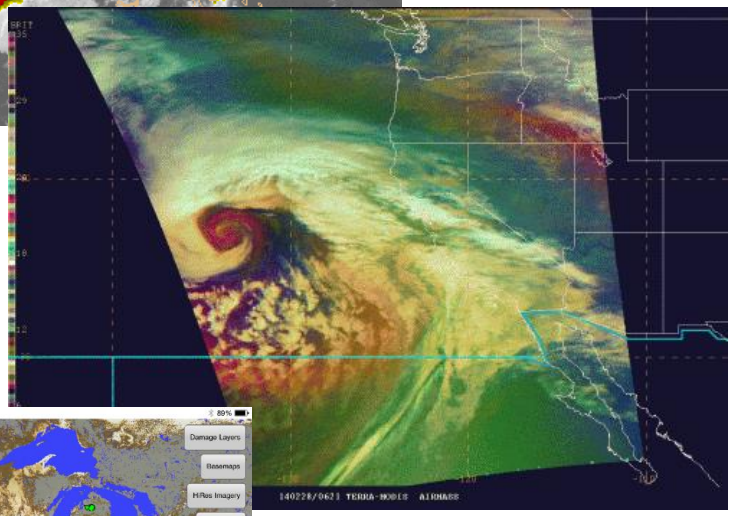
Ingest into Decision Support Systems

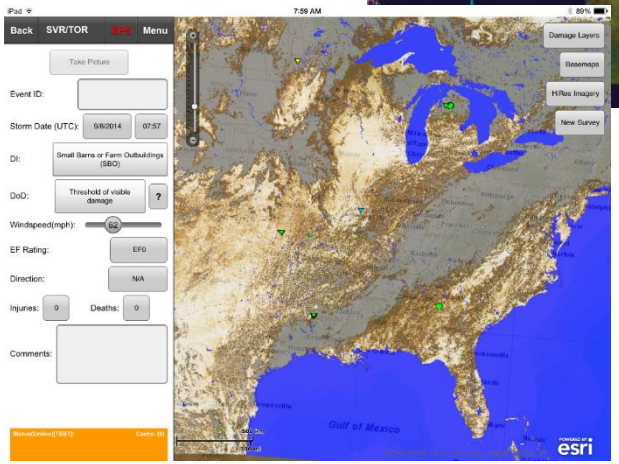
- One key to SPoRT success is integrating NASA datasets into end-user decision support systems (DSS)
- Currently support:
  - Advanced Weather Interactive Processing System (AWIPS) for NWS forecast offices
  - National Centers for Environmental Prediction AWIPS (N-AWIPS) for National Centers (e.g., NHC, WPC/OPC)
  - Web Mapping Service for Disaster Response applications
- Obtain NRT data, generate derived products, format for ingest in appropriate DSS, and transition to NWS using robust data dissemination system



GPM IMERG data overlaying IR imagery in AWIPS (*Anita LeRoy, UAH*)



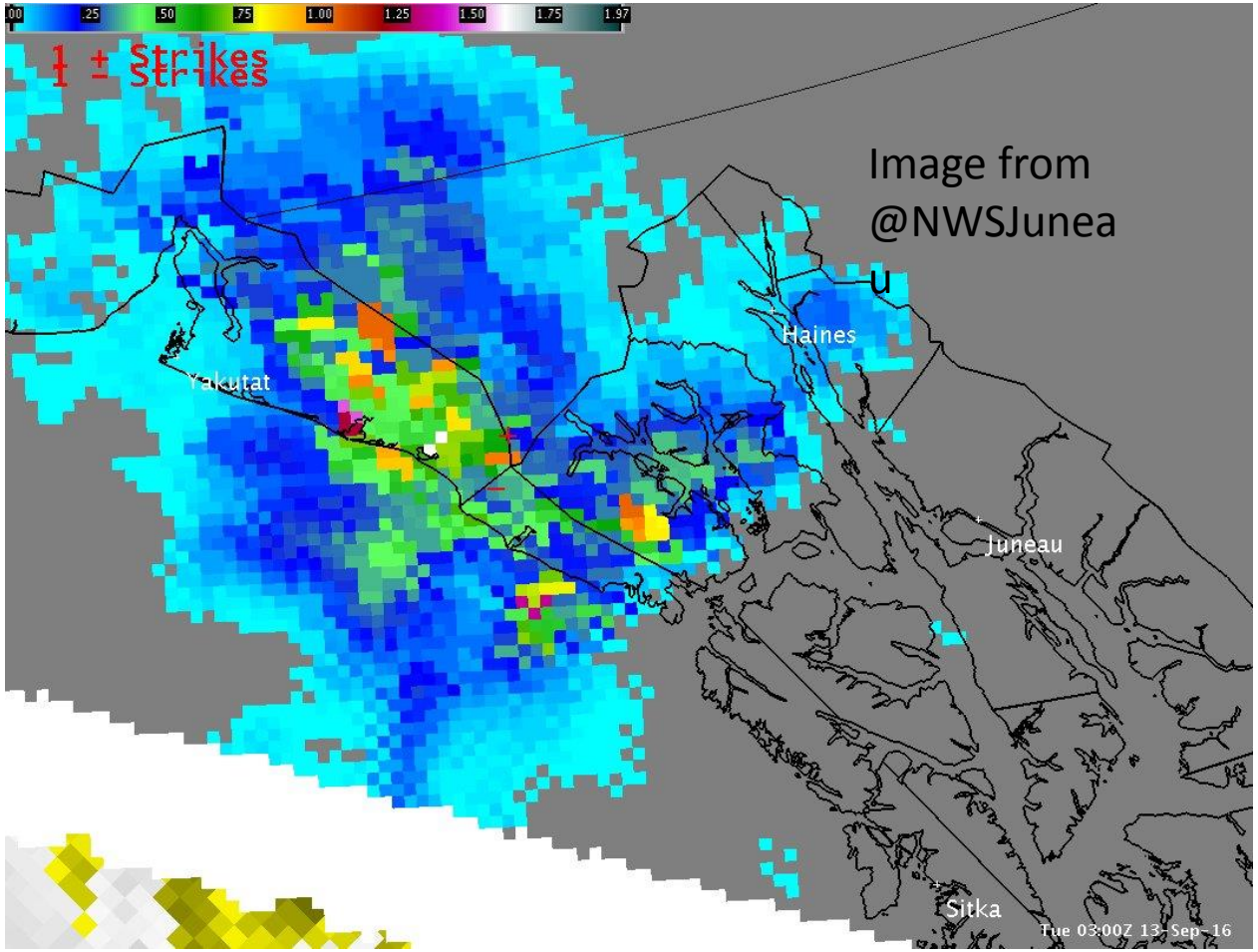
MODIS Airmass RGB product in N-AWIPS (*Michael Folmer, OPC*)



MODIS NDVI difference product shown in the NOAA/NWS Damage Assessment Toolkit (*Andrew Molthan, NASA/MSFC*)

NWS Example

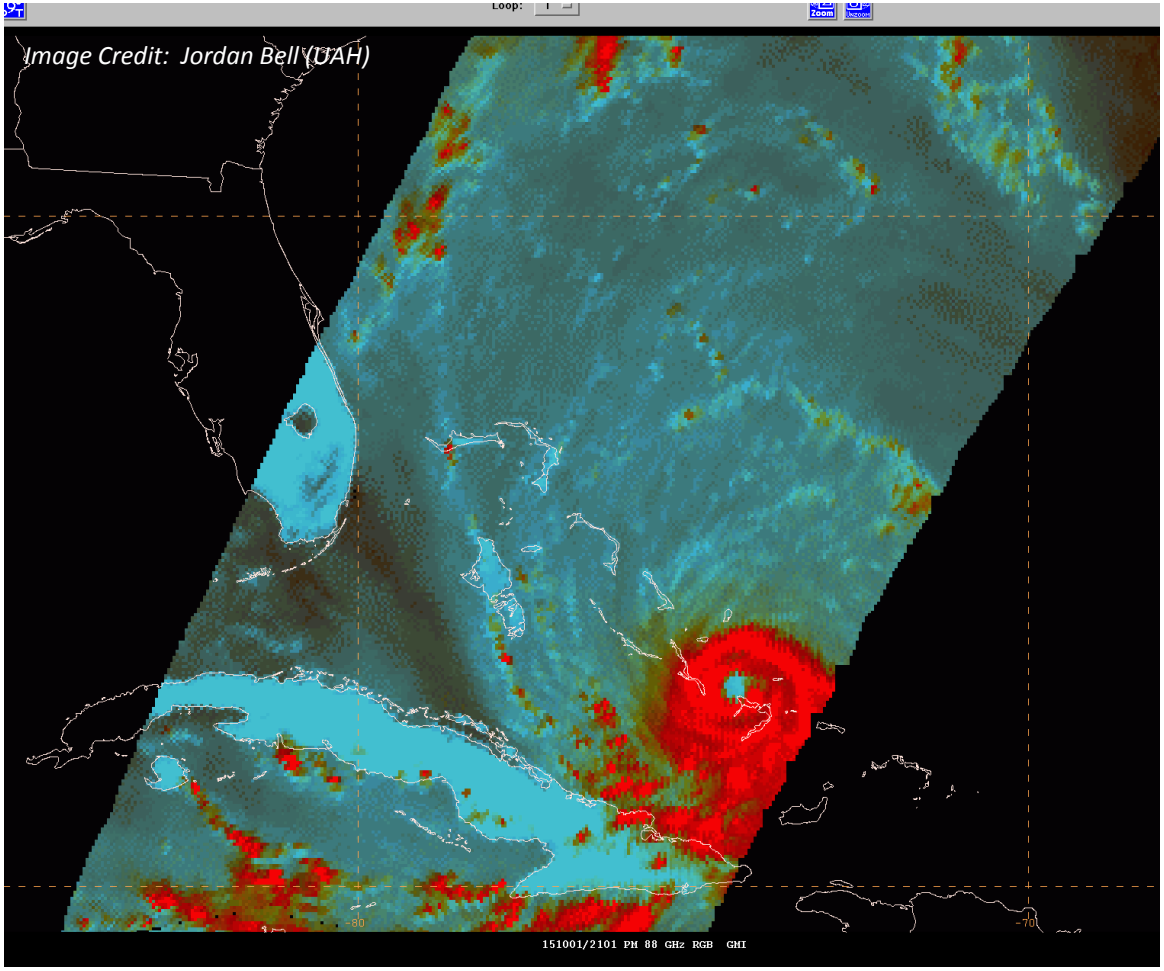
- GPM L2 rain rate and L3 IMERG products are displayed within NWS AWIPS system to add forecasters in detection of precipitation amounts in radar void areas



GPM L2 rain rates overlaying NLDN lightning flashes on 13 September 2016 showing potential atmospheric river event in SE Alaska

NHC Example

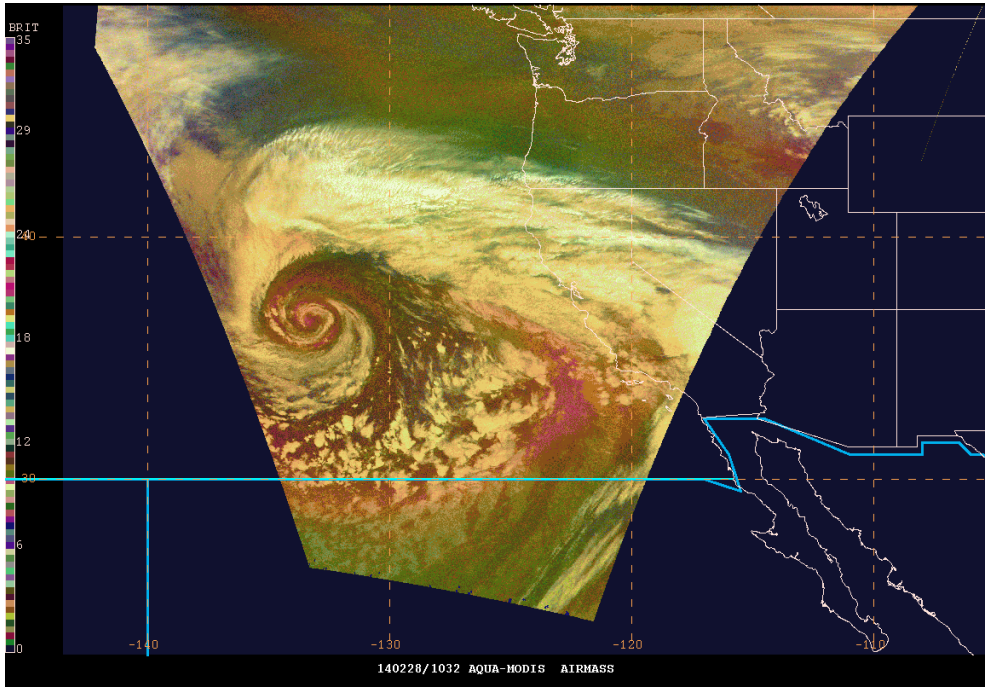
- Forecasters at NHC use NRT GPM Constellation composite products in their N-AWIPS system to pinpoint the center of tropical cyclones and detect the strongest convection



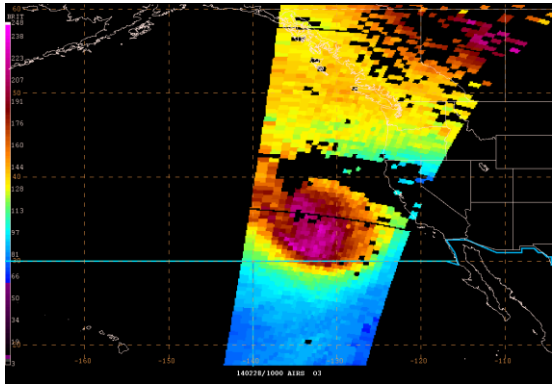
Hurricane Joaquin at 2101Z on 1 October 2015 seen by the GPM Microwave Imager 89 GHz RGB; the eye of the storm is easily identified along with the core of heaviest precipitation in the imagery

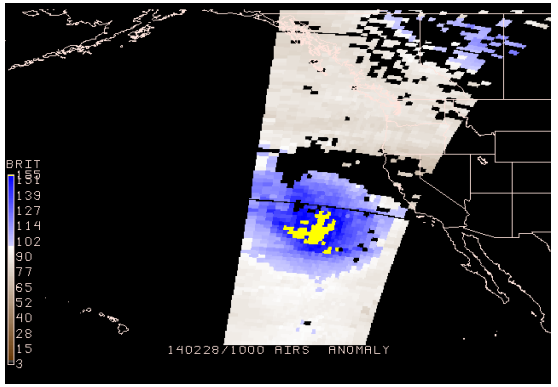
OPC/WPC Example

- Forecasters at WPC/OPC use multispectral imagery from MODIS and total column ozone and derived anomaly products from AIRS in their N-AWIPS system to track mid-latitude cyclogenesis
- When used together, the ozone products confirm the presence of a stratospheric intrusion in the RGB image



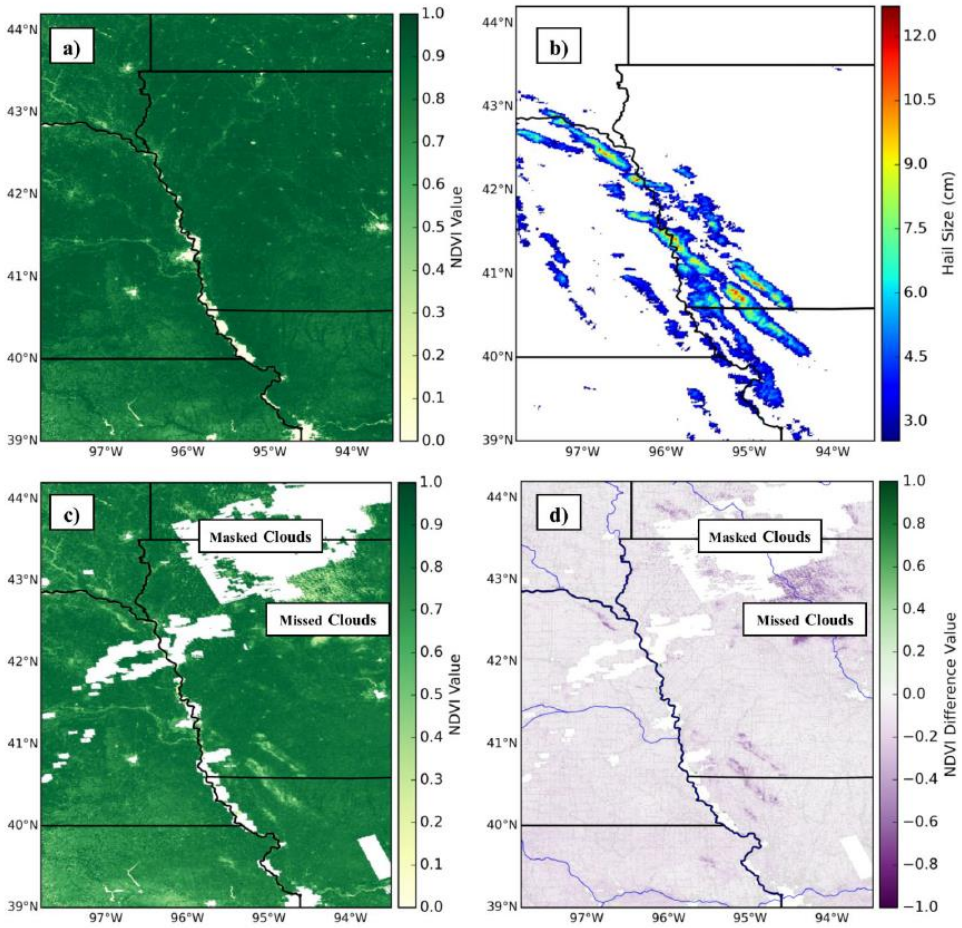
Strong mid-latitude cyclone depicted in Aqua MODIS Airmass RGB imagery at 1032Z on 28 February 2014 (above); AIRS total ozone (below left) and ozone anomaly (below right) data show presence of a stratospheric intrusion consistent with rapid cyclone intensification





WMS Example

- Developed a means of identifying hail damage scars using a combination of NRT MODIS NDVI and LST that can be distributed to end users via WMS for near real-time analysis.
- Algorithm looks for coincident NDVI degradation and increases in LST, along with hail occurrence, with the intent of improving mapping of hail damage by NWS meteorologists using the NOAA/NWS Damage Assessment Toolkit.



Examples of a) pre-event NDVI composite, b) hail occurrence in mid August 2011, c) hail scars apparent in the subsequent NDVI, and d) first step of identifying NDVI anomalies. See Bell and Molthan (2016) for more details. Doi: http://dx.doi.org/10.15191/nwajom.2016.0411

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Desired NRT Datasets/Capabilities

- There is a community need for extending the MODIS API and/or FTP capability to VIIRS and other key S-NPP data sets
  - Easier acquisition and processing of OCONUS regions for disasters or international application partners with SERVIR
  - There are large gaps in the North Atlantic and Pacific where geostationary data is stretched and polar-orbiting data can be very useful (e.g., forecasters at National Centers have been requesting VIIRS data with reduced latencies since the launch of S-NPP)
  - Currently no source of global VIIRS or OMPS data with latency less than 7 hours; can get NOAA CrIS/ATMS retrievals
  - VIIRS reflectance and brightness temperatures, day-night band, cloud products (e.g. cloud top pressure, masks), vegetation index, aerosol optical depth
  - CrIS vertical profiles of temperature, moisture, and ozone for weather analysis and modeling applications
  - OMPS data for volcanic ash and aerosols (e.g., fires) that impact aviation
- Having a MODIS-like API for GPM passive microwave data and rain rates and SMAP retrieved soil moisture would help downselect data for weather applications over specific regional subsets

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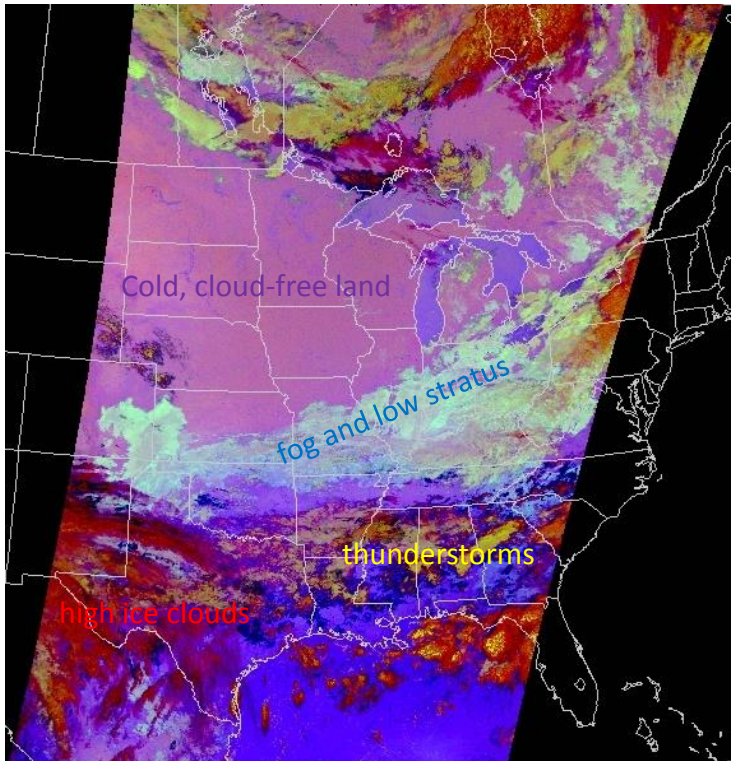
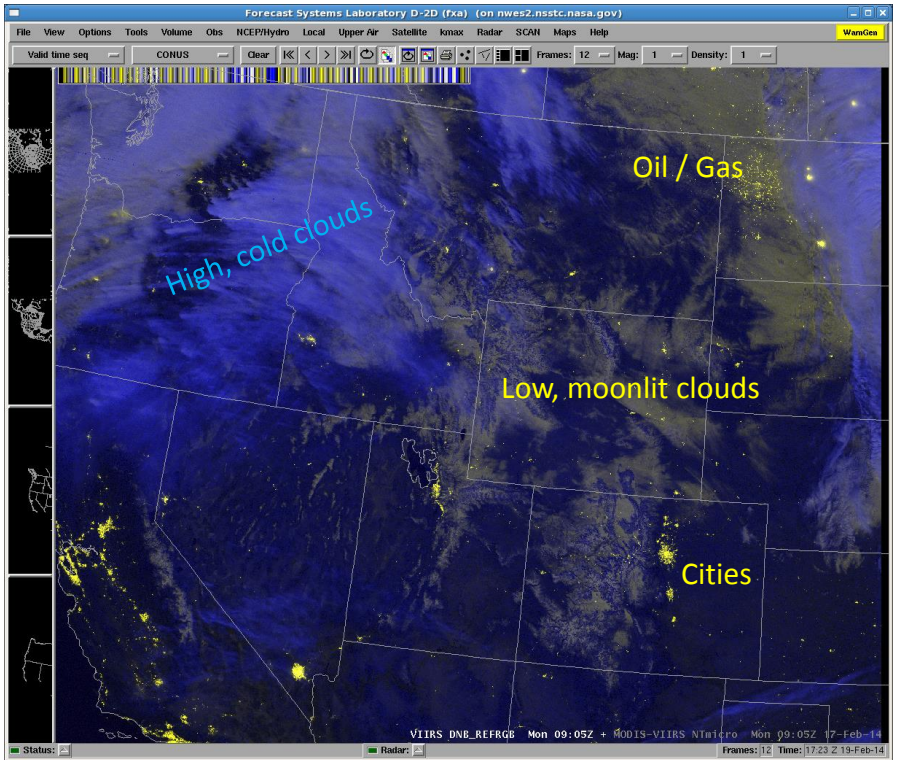
Potential Collaborations



Popular with NWS forecasters, the "nighttime microphysics" composite highlights different cloud features.



Combination of the VIIRS DNB and VIIRS infrared helps to identify and categorize cloud characteristics, especially in periods of low moonlight.

SPoRT can partner with LANCE to explore dissemination of derived products, such as multispectral (RGB) imagery (and training) to highlight MODIS and VIIRS capabilities. Numerous opportunities exist for additional product generation and dissemination to end users.

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Summary

- SPoRT makes extensive use of DB and LANCE products for weather, climate, and disaster applications
- Streamlined APIs that allow for global search and acquisition of MODIS and AIRS products are highly valued
- SPoRT applications continue to grow in use of S-NPP, GPM, and SMAP areas and LANCE-like data access and latencies would be highly beneficial
- SPoRT is ***highly interested*** in developing closer, collaborative partnerships to test and evaluate new LANCE capabilities for S-NPP, GPM, SMAP and other future instruments